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A GENERAL BIOLOGICAL REPORT
RELATIVE TO MISCELLANEOUS FOREST INSECTS

by

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Respectfully submitted

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THE VALUE OF BIOLOGICAL INFORMATION

During the 1933 field season, a small amount of time was given to a study of the seasonal histories and habits of a few important forest insects found in western white pine and Douglas fir. These studies were made either as part of the regular program in order to supplement previous work, or were undertaken as spare time investigations in order to secure information appertaining to the problems under investigation.

There is a great need for fundamental information of this nature. Obviously, sound control recommendations can not be made without possessing a more or less complete knowledge of the seasonal history and habits of the insect involved. In addition, it is now felt that control projects should be planned to preserve the native beneficial insects associated with the inimical insect to be controlled, and this can only be done after seasonal history information has been secured. In short, biological data form the bases for our control methods and should be secured whenever possible, so that they will be available when the need for them arises.

The following notes are incomplete for some of the species, but are included because of their bearing on present problems.

PISSODES CURRIEI HOPK.

This weevil is found associated with the mountain pine beetle in western white pine trees. It restricts its attack almost entirely to the base of the tree, and is most abundant just above and below the ground line in the root collar and the large lateral roots. It was believed that this insect possibly attacked the tree one year prior to the mountain pine beetle and that in association with various Armallaria fungi was the primary agent causing the death of the tree. However, an

examination of 127 infested trees indicated that the weevil attacked the tree the same year as the bark beetle, and more detailed observations on 33 of these trees showed that the weevil deposits eggs from three days to a month after the bark-beetle attack. In no case were the weevils found in green pines although 217 trees were examined, thus showing that they apparently attack only bark-beetle infested trees.

Egg

In general shape and appearance, the egg resembles those of the bark beetles with which it is associated, being spherical in cross-section, suboval in shape, white, glabrous and shining. However, it more closely approaches the spherical than do the bark-beetle eggs, averaging .63 mm. in width and only .88 mm. in length.

Larva

Böving and Craighead [1] state, "The larvae of the Curculionidae and Scolytidae can not be separated. In most of the larvae of these two families, the body is whitish, fleshy, subcylindrical, more or less curved, without abdominal prolegs, and not clothed with long hair." Hence, as the resemblance is so marked in these two large groups, there would be no value to a description of the larva in this paper. However, by the process of elimination, type of gallery, and other non-taxonomic characters, it is possible to distinguish the larvae of *P. curriei* from the other larval forms with which it might be confused. First, as it is found at the bases of white pines, there are only two insects (*Dendroctonus monticolae* and *D. valens*) which would interfere with its

[1] Böving, Adam G., and Craighead, F.C., 1931 An illustrated synopsis of the principal larvae forms of the Order Coleoptera. Booklyn Ents. Soc., page 67.

recognition. The valens larvae can be eliminated immediately, because they possess a heavy, brown, sclerotized caudal plate which is not present on the apical abdominal segment of the other two larval forms. There remains then to separate the weevil larvae from those of _D. monticolae_. In the mature state, the weevil larva is more than twice as large as the monticolae larva, but to separate an immature weevil larva from a more mature monticolae larva one must trace back the larval tunnel. Monticolae larval mines originate from an egg gallery, whereas the weevil mines usually have their origin somewhere on the bark surface and are longer and more winding than those of the mountain pine beetle larvae.

Pupa

The pupa is white and shining, averaging 8.1 mm. in length. It conforms closely to Hopkins' general description of the pupae in this genus [2], but differs from _P. affinis_, its nearest ally, in that there are two

[2] Hopkins, A. D., 1911 Contribution toward a monograph of the bark weevils of the genus Pissodes. U.S.D.A. Technical Series No. 20, Part 1, pages 25-26.

pairs of small spines instead of one pair on the beak between its apex and middle, and the spines on the abdominal tergites are arranged with the larger ones alternating with the smaller in place of the two small spines between the more prominent dorsal ones as in affinis.

In the field, the pupae are readily recognizable because of their position in the shallow pupal cells which are in the sapwood of the tree and have an opening to the outer surface of the wood. The wide opening of the pit is blocked with a plug made of coarse frass so that when the bark of the tree has been cut away, the pupae are not visible until the frass plug has been removed.

Imago

The adult has been described by Hopkins (op. cit.). This species is at once distinguished from other Pissodes by the equal width of the elytral interspaces, the third and fifth of which are not elevated; by the very sparsely placed scales, the obscure anterior spots, the small posterior spot on the elytra, and the coarse and deep strial punctures.

It is a small brown weevil with orange markings, and varies in length from 5.6 to 8.0 mm.

Seasonal History

Adults are found in the field practically throughout the active season from early in May until the first part of October. This may possibly be due to one or more of the characteristic habits of the genus Pissodes such as the long life and hibernating habit of the adult, the slow sexual maturity, and the long period in which eggs may be deposited by a single female. However, the adults are decidedly most abundant during late July and August and the development in all of the trees examined indicated an egg laying period during the late summer. Females were observed in the act of oviposition at this time and eggs were collected from one such oviposition on August 3, 1933. From the above observations, it would appear that any variation from this would be due to some biological variation rather than a definite habit, hence only the one seasonal history will be given in this paper.

Eggs are deposited during the late summer near the ground line in the bark crevices of the lateral roots of western white pine trees infested with the mountain pine beetle. The eggs hatch in approximately 12 days and the small larvae bore through the bark to the sapwood where they feed between the bark and wood. Most of the larvae are mature by late fall, and begin to excavate a shallow pit or pupal cell in the

surface of the sapwood. The winter is passed in the larval stage either in the pupal cells or in larval mines between the bark and wood. By June of the following year, all larvae are in pupal cells and pupation takes place at this time.

The pupal stadium is rather long, averaging 48 days for three weevils reared in the laboratory. In the field, no pupae were found on June 9, but were abundant on June 17. Emergence from these trees began on July 28 and continued throughout August, so that the pupal period extends from approximately the middle of June through July and August.

It also appears that some individuals spend a second winter in the pupal cells and emerge in the spring of the second season. For example, blocks of wood containing weevil pupae were brought into the laboratory for rearing on July 18, 1932. These pupae undoubtedly resulted from eggs deposited during July or August of 1931. Five adults emerged on August 25, 1932, but three did not emerge until May 28, 1933. Although laboratory conditions may have brought about this delayed development, the two-year life cycle for some individuals was partially substantiated by caging experiments. Two cages were constructed July 14, 1933, on the roots of two different white pine trees known to have been attacked by the weevil during August, 1932. Some emerging adults appeared from August 20 to August 28, but were not in the abundance indicated by the number of pupal cells. These cages will be examined again in the spring of 1934 to ascertain if the remainder of the beetles will emerge at that time.

DENDROCTONUS MONTICOLAE HOPK.

A full acount of the seasonal history and other habits of this insect in western white pine are given in another report [3] and so will

3/ Bedard, W. D., 1933 Additional information concerning the biology and habits of the mountain pine beetle in western white pine. Ms. in Forest Insect Field Station, Coeur d'Alene, Idaho.

not be included here. The following data include observations on the mountain pine beetle working in Engelmann spruce, and also the results from a series of caging experiments to study host selection.

The Mountain Pine Beetle in Engelmann Spruce

During the course of the host selection experiments, six infested Engelmann spruce trees were examined to secure adult monticolae from this host. The mountain pine beetle larvae were abundant in all of these trees but in no instance did they develop beyond the small larval stage although the D. Engelmanni, with which it was associated, matured and emerged without any undue mortality having occurred. Whether this is a common occurrence in other parts of the country, or merely a local condition is not known. Although the exact cause has not been determined, the mortality may possibly have been due to a condition within the host unfavorable to the mountain pine beetle, or to a weakened virility of the insect itself.

Host Selection

The possible spread of mountain pine beetle infestations from one host tree to another host of a different species has long remained a matter of conjecture. The lack of knowledge on this subject made doubtful whether an infestation in an inferior tree species should be controlled for fear that it would spread to a merchantable species, or whether the infestation should be allowed to continue with the expectation that it would continue in the inferior species and eventually decrease due to the fact that the supply of this species had been

depleted. Because of the important bearing this matter has on control recommendations, a series of caging experiments were performed in the hope of securing more information on the subject. Although it was realized that in a problem of this nature the results secured from caging experiments were not necessarily conclusive proof of the beetle's habits, nevertheless, it was hoped that evidence would be secured which would indicate the procedure to be followed in planning more extensive studies such as experimental control projects.

The first experiment was instituted in 1932, when western white pine slabs infested with the mountain pine beetle were placed in a cage with green logs from white pine, Engelmann spruce, lodgepole pine, and white bark pine. In this cage the beetles showed a decided selection of hosts by attacking only the white pine. A few days later, this log was removed from the cage and only then were attacks made in the other three logs.

These encouraging results led to a continuation of the study on a much larger scale during 1933. Thirteen cages were constructed within 300 feet of each other in a mixed stand of white pine, lodgepole pine, ponderosa pine, and Douglas fir. Mountain pine beetle infested logs from various hosts and green logs from various hosts were arranged in the cages as follows:

Cage A 1 - White pine log infested with mountain pine beetle. Green logs from white pine, lodgepole pine, ponderosa pine, white bark pine, and Engelmann spruce. One set of green logs was cut and placed in the cage on June 20, and another set of fresh material was cut and placed in the cage on July 4 when the first emerging beetle appeared, so that both old and fresh material were available for attack.

Cage A 2 - White bark pine log infested with mountain pine beetle. Green logs from white pine, lodgepole pine, ponderosa pine, white bark

pine, and Engelmann spruce placed in the cage at the time of construction.

Cage A 3 - Similar to A 2 except infested material was mountain pine beetle in lodgepole pine.

Cage A 4 - Similar to A 2 except infested material was mountain pine beetle in ponderosa pine.

Cage A 5 - Planned to be similar to A 2 with mountain pine beetle in Engelmann spruce, but no adults could be found in this host, so the cage was abandoned.

Cage B 1 - White pine log infested with the mountain pine beetle. Green white pine log placed in cage at time of construction and green lodgepole log placed in cage when beetles began to emerge.

Cage B 2 - Similar to B 1 except the logs for attack were old lodgepole pine and fresh white pine.

Cage B 3 - Lodgepole pine log infested with mountain pine beetle. Logs for attack were old lodgepole and fresh white pine.

Cage B 4 - Similar to B 3 except logs for attack were fresh lodgepole and old white pine.

Cage C 1 - A long narrow cage with the central part occupied by a white pine log infested with the mountain pine beetle. In one end of the cage was a green white pine log heavily shaded by branches placed on the top and sides of the cage. A green white pine log was placed in the other end of the cage and exposed to normal light.

Cage C 2 - Similar to C 1 except a green lodgepole log was shaded and a green white pine log exposed.

Cage C 3 - Similar to C 2 except both logs were exposed and fresh white pine slashings were placed near the lodgepole log on the outside of the cage.

Cage C 4 - Similar to C 2 except the white pine log was shaded and the lodgepole log exposed.

The results secured from these cages are somewhat disconcerting in the face of what had occurred in the 1932 cage. The beetles attacked with such abandon and apparent disregard of tree species that the data may best be discussed in generalities rather than to attempt any tabulation of details. In the series of "A" cages, all logs were attacked in varying numbers and with no correlation between cages indicating any host preference. In the "B" series, the attacks were even more uniformly distributed so that apparently no preference was shown for either old or fresh material. The "C" series cages were the only ones which showed any indication of a preference. In cage C 1, the exposed white pine log received four times as many attacks as the shaded log, indicating that the exposed log was preferable. In cage C 4 however, the shaded white pine log received twice as many attacks as the exposed lodgepole, in spite of the shading. Thus, if the results in cage C 1 are true, then in cage C 4 a very decided preference was shown for the white pine. In both C 2 and C 3 the selection of white pine over lodgepole was again very marked, although attacks were made in both species.

There are admittedly several possibilities for error in these experiments, the most obvious being the improper selection of the green logs for the cages. Certain trees within a stand seem to be immune from bark beetle attack and if logs from one of these trees had been placed in the cages, the results would show a selection which would not be the true one as it occurs in the forest. There are then two interpretations which can be placed upon the preceding data: (1) that the caging experiments involved too many uncontrollable factors and therefore the results can not be used, and (2) that the caging experiments were successful in showing that the mountain pine beetle makes no selection between its five hosts.

Obviously, monticolae does make a selection, in that it restricts itself to the various pines and Engelmann spruce, but this does not necessarily indicate that a mountain pine beetle working in white pine will continue to attack that tree species and not other pines. The caging experiments at least show quite definitely that beetles from one host can attack certain other hosts and generate successful broods. It is possible that monticolae in one host will continue in that host as long as material for attack is available, but I believe that a successful transfer to another host species can be made when the supply of the preferred host is depleted.

Swaine believes that these beetles do not restrict themselves to one host, for he states, [4] "On the other hand, workers in British Columbia

[4] Swaine, J. M., 1933 The relation of insect activities to forest development as exemplified in the forests of Western North America. Scientific Agriculture 14:1:8-31.

have long been convinced that in the forests of that province outbreaks of the mountain pine beetle have on numerous occasions developed in lodgepole forests and have spread down the slopes and into the yellow pine stands below. It is difficult to obtain conclusive proof under field conditions, but a study of the development and extension of these outbreaks in British Columbia, extending over a period of many years, has convinced entomologists there that outbreaks of these beetles in lodgepole pine spread readily enough into yellow pine in the neighborhood.

"Experimental work with large cages has disclosed no evidence of any decided host selection. Infested lodgepole pine logs were enclosed in cages with an equal number of freshly cut lodgepole pine and yellow pine logs, and infested yellow pine logs were treated in the same manner. Several of these cages were employed in each of three successive years.

In no instance was any preference shown. The beetles which emerged from yellow pine or from lodgepole pine went in approximately equal numbers into the yellow pine and into the lodgepole pine logs provided in the cages. It should be noted that this beetle breeds readily enough in cages of the type employed in the experiments, and there is, therefore, little reason to suppose that the caged conditions distracted them from the exercise of any normal preference."

PHAONIA n. sp.

While studying the parasites and predators of the mountain pine beetle, the writer discovered a Dipterous larva new to him, associated with the beetle beneath the bark of western white pine trees. A number of these larvae were collected and placed in rearing vials in the field laboratory. Throughout their larval stadia they fed voraciously on mountain pine beetle larvae, finally pupated and emerged as adults. A comparison of the adult flies with material in the local collection showed that H. J. Rust and D. DeLeon had made collections which were determined as Phaonia n. sp. of the family Anthomyidae. A brief account of the seasonal history, with descriptions of all developmental stages excepting the egg, are given in the following paragraphs.

Larva

Length of mature larva 13 mm. White, shining, nude and without markings. Cylindrical, tapering anteriorly from the apical abdominal segment. Body composed of head, three thoracic and eight abdominal segments. Head retractile, bears minute antennae and the buccal armature; mouth parts partly visible through head and thorax, giving head a black appearance; buccopharangial armature appearing as in figure 1. Thorax with prothoracic respiratory organs elevated, fan-shaped, 5-lobed. Abdomen with

pseudopodia ventrad, on the anterior margins of each segment; pseudopodia with bands of minute locomotor spinules, arranged as in figure 2; posterior spiracles raised, about as thick as high, each on a flat sclerotized plate about three times the diameter of the spiracles.

Puparium

Length 8 - 9 mm. Dark red, shining. Cylindrical, moderately tapered at both ends, the anterior slightly more than the posterior; posterior somewhat abruptly truncated. Surface smooth except for microscopic transverse ridges on the venter of each abdominal segment, the central ridge larger than the others; ridges gradually more pronounced from the second segment towards the apical segment and extend to the dorsum on the fourth, fifth and sixth abdominal segments; anterior and apical segments strongly ridged, ridges appearing as wavy concentric circles surrounding the respiratory organs; bands of locomotor spinules, present on larval pseudopodia, visible on puparium. Anterior respiratory organs raised, fan-shaped, 5-lobed; metathoracic spiracles elevated, slender, each about twice as high as its widest diameter, tapered apically and curved so the apex is directed anteriorly; posterior spiracles elevated, as thick as high.

Pupa

Length 7 - 9 mm. White, shining; bristles testaceous. Closely resembles imago in shape and chaetotaxy. Wings extend almost to apex of third abdominal segment; fore legs extend to middle of fourth abdominal; mid legs to middle of fifth abdominal; hind legs almost to apex of abdomen.

Imago

Femal - Length 7 - 9 mm. Color black, distinctly shining, with dense bluish-grey pruinescence on head, thorax, abdomen and femora; orbits with

the priunescence distinctly silvery; interfrontalia velvety black; parafacials and lunule less silvery than orbit and with apical portions obscurely reddish; antennae black, second joint lighter, obscurely reddish; palpi black. Thorax quadrivittate with a lateral vitta on each side on the declivitous portion of the mesonotum. Tibiae slightly paler than femora, somewhat infuscated. Wings hyaline. Calyptrae yellow with margins orange. Halteres yellow. Eyes Indian red. Head with eyes sparsely hairy, the hairs very fine and short; narrowest part of frons five times as wide as the distance across the posterior ocelli; orbits with strong bristles from base of antennae to vertex; strong bristles on occiput and cheeks; vibrissae long and stout; longest hairs on arista as long as half the width of the third antennal segment. Profile as in figure 3. Thorax with hypopleura bare; presutural dorsocentrals six, four long, two short; postsutural dorsocentrals eight, long; presutural acrostichals six, short; postsutural acrostichals four, long; supra-alars as long as the longest thoracic bristle. Hind tibia (fig. 4) with the apical posterodorsal bristle about half the length of apical dorsal; calcar one fifth of the distance from the apex of the tibia to the base; centro-apical fourth of the posterior surface bearing three bristles; two long bristles present near the center, one on the posterodorsal and one on the dorsal surface; apex of tibia with five bristles, the central one longer and stouter than the others. Mid-tibia similar, but lacking the posterocentral bristles. Fore tibia lacking all but the apical bristles. Abdomen broadly ovate, tapering sharply at the apex; basal tergite with small dense setae, except on apical fourth; basal fourth of second tergite bare; remainder of second tergite and all other tergites evenly setulose with medium sized setae; setae longer on apical margins.

Fig. 1

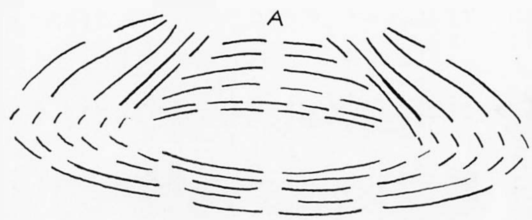

Fig. 2

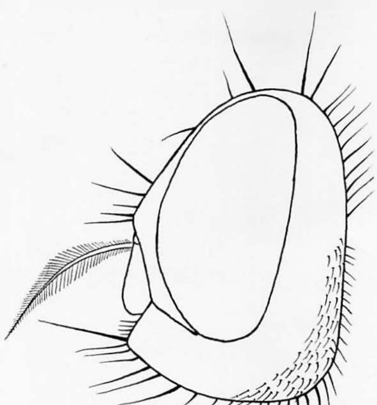

Fig. 3

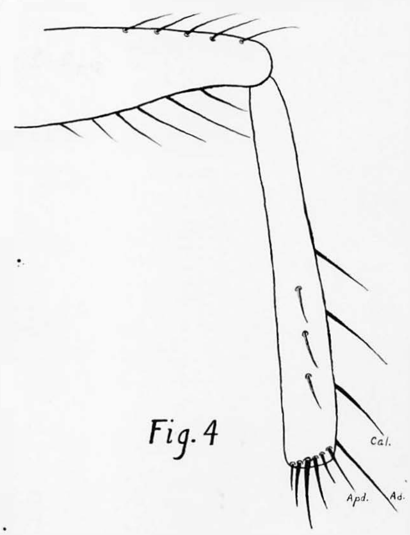

Fig. 4

Male - Length 7 - 8 mm. Differs from female in having the narrowest portion of the frons about as wide as the distance across the posterior ocelli; apex of abdomen rounded, not sharply tapered, and with bristles longer and more dense.

Seasonal History

This insect has a one-year life cycle with no apparent variations. Adults begin to appear during late June, are most abundant in July and can no longer be found after the middle of August. The greatest amount of egg-laying undoubtedly occurs during July, but I have never been able to secure any eggs either from observing ovipositions in the field or from rearing the adults in the laboratory. Larvae are abundant in early September and have reached maturity by the end of the active season. They are found only in the trees attached by D. monticolae during June and are most abundant on the moist underside of windfalls. In the laboratory, considerable moisture must be supplied or the larvae will not mature.

The winter is passed in the larval stage and pupation takes place during May and June of the following year. For 21 larvae reared in the laboratory, the average length of the pupal stadium was 23 days.

DENDROCTONUS PSEUDOTSUGAE HOPK.

A full account of the seasonal history and other habits of this insect are given in another report [5] and so will not be included here. The following data are concerned with a study of brood potential and how it may be used to predict the future increase or decrease of an infestation. The

[5] Bedard, W. D., 1933 The Douglas fir beetle. Its seasonal history, biology, habits, and control. Ms. in Forest Insect Field Station, Coeur d'Alene, Idaho.

initial work is being done in Douglas fir and if successful with the Douglas fir beetle, it is planned to extend the study to include all bark beetles of this region. The study was instituted during the fall of 1932 when a 100 percent survey was made of 320 acres of Douglas fir timber infested with the Douglas fir beetle. Following the survey, the brood potential in 12 trees surrounding the 320-acre plot was determined by bark examination. The survey and brood counts were repeated during the 1933 season. In examining the two years' data from this study, it is found that there are two variable factors which do not permit of an accurate prediction. Additional work must be done on this problem and certain changes in technique must be made before a final conclusion can be drawn as to the feasibility of judging the status of an infestation by the brood potential.

Douglas Fir Cone Moth

-- Zeiraphera Diniana Guenée
or
Enarmonis pseudotsugae

This insect has not been determined, and I am unable to find from the literature whether there are two species or whether these names are synonomous. On July 10, 1933, it was noted that green Douglas fir cones were falling from the trees in great numbers and upon examination it was found that most of these cones contained either mature larvae of the Douglas fir cone moth or some of its parasites. One cone contained two cone moth larvae, but all of the others were infested by only one larva.

Cones were examined daily, and by July 30th all of the larvae had transformed to pupae. The pupae were found beneath the cone scales approximately where a seed should be. This position of the pupa probably permits easy emergence in the spring when the cone opens.

No emergence was noted in the fall of 1933, and as the moths began to emerge in the rearing jars in a warm room on January 8, 1934, they

probably winter over in the pupal stage and emerge in June of the following year at which time the new cones have attained sufficient growth for oviposition by the moths.

Aradus proboscideus Walker

This Hemipteron feeds on the eggs and tiny larvae of the Douglas fir beetle. During the past season a number of the adults were kept in rearing, and ten eggs were secured. The egg is spherical in cross-section, oval in shape, with one end more tapered than the other. The color is white and very shining; chorion slightly roughened and moderately covered with short fine hairs. The egg averages .982 mm. in length and .567 mm. in width.

Forcipomyia sp. (Hopk. U. S. No. 21353 - 21354)

The egg of this fly averages .233 mm. in length and .078 mm. in width; is spherical in cross-section and narrowly oval in shape. The color is white, shining and translucent. Two long hairs are visible, one on either side of the egg near one end. Although some of the species in this genus are parasitic, all of the observations on the larvae of this species indicate that it is saprophagous.

Sciara sp. (Hopk. U. S. No. 20223)

One female fly of this species laid 175 eggs in a mass over a period of 24 hours. The egg is spherical in cross-section, oval in shape, averaging .253 mm. in length and .143 mm. in width. It is almost colorless, smooth and shining, resembling clear glass. The larvae of this insect also appear to be saprophagous.